PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Electrical Semi-Conductor Device

We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of Connaught House, 63 Aldwych, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electrical semiconductor devices, and in particular to power rectifiers including a semiconductor element having two flat surfaces which are electrically connected to two conductors.

It is an object of the present invention to provide a device which has pressure assisted contacts to the semiconductor element.

According to the present invention there is provided an electrical semiconductor device, including a semiconductor element having two flat surfaces which are electrically connected to two electric conductors, characterized in that it includes a first and a second casing part, that said first casing part supports a stack consisting of a first disc, said semiconductor element and a second disc, said first casing part constituting one of said two electric conductors, that the upper part of said second casing part which is substantially bell-shaped is provided with an insulating portion having an opening therein, said opening affording a sealed passage for the other of said two electric conductors, that said other electric conductor comprises a rigid stem which terminates at an abutment the diameter of which is larger than that of said opening and which makes contact with said second disc, and that a spring element is mounted between said abutment and said insulating part, and that said first and second casing parts are interconnected so as to compress said spring element, thus pressing said stack between said first casing part and said abutment.

[Price 4s. 6d.]

It should be noted that in case the surfaces of the semiconductor element are directly pressed between the surfaces of two electric conductors, there is great danger from breaking the semi-conductor element, due to the fact that surfaces of the latter element generally never completely correspond to those of the electric conductors.

The above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of embodiments taken in conjunction with the accompanying drawings in which:

Fig. 1 shows a cross-section of a semiconductor device and more particularly of a power rectifier according to the invention;

Fig. 2 represents a cross-section of a part of a controlled power rectifier according to the invention.

Principally referring to Fig. 1, the power rectifier comprises casing parts 1 and 2, a rigid stem 3, two discs 4 and 5, a silicon rectifier 6, a helical spring 7, a support 8 and a fixing ring 9.

The cylindrical casing part 1 has a T-shaped cross-section and presents an annular groove 10 in its upper surface. It is forced in a cavity of the support 8 so as to ensure a good thermal contact with the latter. This support is provided with cooling fins. The casing part 1 is made of copper which is nickel and gold plated and constitutes one electrical conductor. The steel casing part 2 is bell-shaped and is provided at its top part with a tubular element 11 which is connected to the casing part 2 by means of the insulating part 12. The lower part of the casing part 2 has a larger diameter than the remaining part of this casing part 2, the lower free edge of which is cut obliquely. This free edge is inserted in the annular

groove 10 of the casing part 1. The tubular element 11 affords a passage with a tight fit for the rigid stem 3 which is made of copper which is nickel and gold-plated. This stem 3, which constitutes the other electric conductor, is provided at its lower part with a number of transverse parallel incisions, such as 13, which are alternatively made at the one and the other side of an axial plan of the stem. This stem terminates in an abutment 14 he diameter of which is larger than that of the tubular element 11. The helical spring 7 is mounted between the abutment 14 and the annular insulating part 12. A stack constituted by the disc 4 which is made of tin, i.e. a malleable material, the silicon rectifier 6 the surfaces of which are nickel and gold plated, and the disc 5 which is also made of tin, is placed on the upper surface of the casing part 1. The abutment 14 makes contact with the tin disc 5. Before fixing the casing part 2 on the casing part 1 the groove 10 is filled with solder, whereafter the lower edge of the casing part 2 is introduced in this groove 10. The ring 9 is then mounted as shown, so that it makes contact with the lower part of casing part 2. In this manner, when screwing the screws 15, the free edge of the casing part 2 is drawn into the groove 10 filled with solder. Hereby the helical spring 7 is compressed and this spring has been so calculated that when the ring is completely fixed on the support 8, this spring 7 exerts a pressure of between 80 kg/cm^2 to 100 kg/cm^2 on the stack 4-6. In a manner not shown, the casing part 1 is connected to one terminal of an AC source, whereas the rigid stem 3 is ultimately connected to the other terminal of this AC source by means of a cap covering the upper part of the tubular element 11.

The solder in the groove 10 realizes a tight connection between the casing parts 1 and 2. The transverse incisions 13 in the stem 3 have been provided to account for thermal expansion. The lower surface of the abutment 14 and the upper surface of the casing part 1 have been lapped in order to ensure a good contact with the tin discs 5 and 4 respectively.

Generally the edge part of the silicon rectifier 6 has been etched in order to obtain better rectifying characteristics. This edge part then has a smaller thickness than the remaining central part of the rectifier and is brittle. Therefore the diameters of the discs 4, 5 and of the abutment 14 are chosen equal to the diameter of the central part of the rectifier, so that the outer part of the rectifier is not located between the discs 4 and 5 and may hence not break upon exerting a pressure on these discs.

Also the central part of the silicon rectifier will not break when subjected to a pressure even when it is not completely flat. Indeed, due to the fact that the discs are made in a malleable material they always remain intimately in contact with the casing part 1, the rigid stem 3 and more particularly with the silicon rectifier 6.

Principally referring to Fig. 2, there is shown a part of a controlled power rectifier, the parts identical to those shown in Fig. 1 being indicated by the same reference numerals. This power rectifier comprises casing parts 1 and 2, a rigid stem 3, two discs 4, 16 a ring 17, a silicon rectifier 18, a ring-shaped element 19, two helical springs 7 and 20, a control wire 21, a support 8 and a fixing element 9.

The silicon rectifier 18 is of the NPNP type and well known in the art. Its lower surface constitutes a zone of the P-type, whereas its upper surface comprises a central zone of the N-type and a peripheral zone of the P-type. The lower surface is covered by a nickel and gold layer (not shown). The upper surface is also covered by a nickel and gold plated layer except for the junction between the above central and peripheral zones which is covered by an insulating and surface protecting layer of silicon dioxide (not shown). The plated lower surface and the plated parts of the above central and peripheral zones constitute the electrodes of the power rectifier. The tin disc 16 is placed on the plated part of the central zone and the tin ring 17 is placed on the plated part of the peripheral zone. The ring-shaped element 19 is further placed on the tin ring 17 and the abutment 14 makes contact with the tin disc 16. The helical spring 20 is mounted between the ring-shaped element 19 and the insulating part 12 of the casing part 2. Between the helical springs 7 and 20 is mounted a cylinder 22 of an insulating material. The cylinder 22 and the above silicon dioxide zone electrically insulate the tin disc 16, the abutment 14 and the spring 7 from the tin ring 17, the ring-shaped element 19 and the spring 20. Finally the control wire 21 extends through an opening in the insulating part 12 and is electrically connected to the upper P layer via the ring-shaped element 19.

WHAT WE CLAIM IS:—

1. Electrical semi-conductor device, including a semi-conductor element having two flat surfaces which are electrically connected to two electric conductors, characterized in that it includes a first and a second casing part, that said first casing part supports a stack consisting of a first disc, said semi-conductor element and a second disc, said first casing part constituting one of said two electric conductors, that the upper part of said second casing part which is substantially bell-shaped is provided with an insulating portion having an opening therein, said opening affording a sealed passage for the other of said two electric conductors, that said

other electric conductor comprises a rigid stem which terminates at an abutment the diameter of which is larger than that of said opening and which makes contact with said second disc, and that a spring element is mounted between said abutment and said insulating part, and that said first and second casing parts are interconnected so as to compress said spring element, thus pressing said stack between said first casing part and said abutment.

2. An electrical semi-conductor device as claimed in claim 1, characterized in that said semi-conductor element comprises a plurality of layers of P-type and N-type conductivity, the one flat surface of said semi-conductor element presenting a conductive zone of P-type or N-type and the other flat surface of which presenting at least two conductive zones of P- or N-type the junction between these zones being covered by an insulating surface layer that said first casing part supports a stack constituted by said first disc, said semi-conductor element, said second disc covering the conductive part of one of said two zones and a ring covering the conductive part of the other of said two zones, that the spring element is replaced by a first and second spring element and that the first spring element which is mounted between said abutment and said insulating part, that a ring-shaped conductive element covers the upper surface of said ring and is connected to a control wire which protrudes through an opening in said insulating part, that the second spring element is mounted between said ring-shaped conductive element and said insulating part, that said first and second casing parts are interconnected so as to compress said first and second spring elements, thus pressing said stack between said first casing part, on the one hand, and said abutment and ring-shaped conductive element on the other hand, and that another insulating member is mounted between said second disc, said abutment and said first spring element, on the one hand, and said ring, said ring-shaped conductive element and said second spring element, on the other hand.

3. An electrical semi-conductor device as claimed in claim 1 or 2, characterized in that the pressure exerted by each of said spring elements is between 80 kg/cm² and 100 kg/cm².

4. An electrical semi-conductor device as claimed in claim 1 or 2, characterized in that said first casing part is provided at its upper surface with an annular groove and that the lower free edge of said second casing part is inserted in said groove and pressed therein by means of a ring-shaped fixing element.

5. An electrical semi-conductor device as claimed in claim 4, characterized in that said groove is filled with solder.

6. An electrical semi-conductor device as claimed in claim 4, characterized in that said first casing part is mounted in a cavity of a support with cooling fins to which said ring-shaped element is fixed.

7. An electrical semi-conductor device, as claimed in any one of the preceding claims including a semi-conductor element the flat surfaces of which are electrically connected between two electric conductors, characterized in that said rigid stem is provided with incisions in a plane parallel to at least one of said flat surfaces of the semi-conductor element.

8. An electrical semi-conductor device as claimed in claim 7, characterized in that said incisions are alternatively made at the one and other side of an axial plan of said one electric conductor.

9. An electrical semi-conductor device substantially as described with reference to the accompanying drawings.

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1,031,233 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

FIG.1.

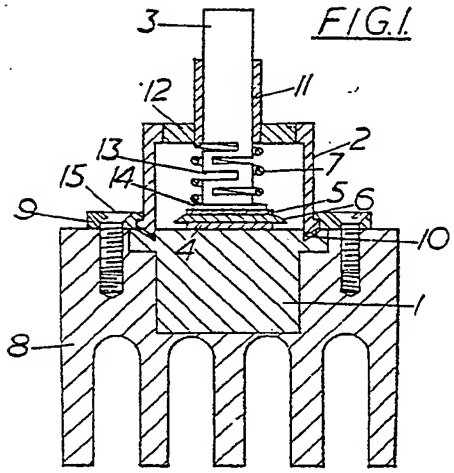

FIG.2.